Method of and Apparatus for Communicating

Field of the Invention
This invention relates to a method of communicating between first and second radio transceivers. This invention relates also to a system, and to a radio transceiver.

Background of the Invention
Various radio channel types exist today for use by portable radio transceivers, global
10   system mobiles (GSM) speech channels, general packet radio service (GPRS), Bluetooth and wireless local area network (WLAN) being examples of such channel types. Furthermore, the universal mobile telephone system (UMTS) allows the transfer of audio-visual information in both directions between portable radio transceivers. The term now adapted for portable radio transceivers of the UMTS
15   standard is mobile station (MS), and this term is used hereafter to describe a mobile radio transceiver capable of communicating in any system.

With many MSs being equipped to communicate with two or more different channel types, it has become common for a user of an MS to have to decide which type of
20   communication channel to use, which can constitute an inconvenience.

Summary of the Invention
According to a first aspect of the invention, there is provided a method of communicating, the method comprising: effecting communication between first and
25   second radio transceivers via a telecommunications network over a first channel; determining the distance between the first and second radio transceivers; determining whether the distance between the two transceivers meets a predetermined threshold; and in response to a determination that the threshold is met, effecting direct mode communication between the first and second radio
30   transceivers over a second channel.

The invention also includes a radio transceiver, comprising: a communicator for communicating with a remote radio transceiver via a telecommunications network

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over a first channel; a determiner for determining the distance between the transceiver and the remote transceiver, and for determining whether the distance meets a predetermined threshold; and a channel charger, responsible to a determination that the threshold is met, for effecting direct mode communication
5   between the transceiver and the remote transceiver over a second channel.

The second channel may have a greater bandwidth than the first channel and the first and second channels may be of different channel types. The method may include, prior to the effecting direct mode communication step, estimating the
10   quality of the second channel. The determining steps may be carried out at the first radio transceiver and the distance determination step may include determining the locations of the first and second radio transceivers.

The location determination may involve a satellite-based position system or may
15   involve triangulating from plural fixed radio transceivers, preferably forming part of the telecommunications network.

The direct mode communication step may be effected only if a bandwidth or other service demand exceeds the capability of the first channel.
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Moreover, the threshold can be dependent on, preferably equal to, the sum of the radio coverage of the first and second radio transceivers.

The invention also extends to a system for effecting communication between first
25   and second radio transceivers, comprising: a communicator for effecting communication between the first and second radio transceivers over a first channel; a determiner for determining the distance between the transceivers, and for determining if the distance meets a predetermined threshold; and a channel charger responsive to a determination that the threshold is met, for effecting direct mode
30   communication between the transceivers over a second channel.

The invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a schematic drawing of a mobile station according to one aspect of the invention;

5   Figure 2 is a schematic diagram of a telecommunication system according to one aspect of the invention and including the mobile station of Figure 1;

Figure 3 is a flow chart illustrating operation of the mobile station of Figure 1; and

Figure 4 is a chart showing signalling effected according to one embodiment.

10   **Detailed Description of the Embodiments**

Referring to Figure 1, a first mobile station (MS) 10 comprises generally a housing 11, an antenna 12, which is connected to transmit and receive circuitry 13, and a central processing unit (CPU) 14. The CPU 14 is connected to the transmit and receive circuitry 13 in four parallel paths 15-18, each path including a respective one

15   of a Bluetooth module 19, a UMTS speech channel module 20, a WLAN module 21 and a UMTS audio-visual module 22. A database 24 containing threshold information, also is connected to the CPU 14. Each of the modules 19 to 22 is configured to allow the first MS 10 to communicate via radio over a different respective channel type. Moreover, each of the channel types has a different bit

20   rate, which equates to bandwidth, namely around 100kb/s for UMTS speech, 1Mb/s for Bluetooth, 10Mb/s for UMTS A-V, and around 100MB/s for WLAN.

The first MS 10 optionally includes a global positioning system (GPS) receiver 23 which is arranged, in response to a request by the CPU 14, to determine the location of the MS, and to provide location information to the CPU. A receiver operable

25   with another positioning system (such as Glonass or the proposed Galileo) could be used in place of the GPS receiver 23.

Operation of the MS 10 in a telecommunications system will now be described with reference to Figure 2.

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In Figure 2, the MS 10 is shown communicating with a first base station (BS) 30 of a UMTS system 31. Second to fourth BSs on 32-34 are shown, along with their respective areas of coverage (the boundaries of which are given by dotted-line

circles). Second to fourth MSs 35-38, are shown in communication with various ones of the BSs 30, 32-34.

In this example, the first MS 10 is connected for speech communication with the

5   second MS 35 over a UMTS speech channel. To this end, the first MS 10 is connected to the BS 30 via a two-way UMTS speech channel, as is the second MS 35. Alternatively, the second MS 35 could be connected via the second BS 32, in which case data would pass between the second BS and the first BS 30 via the network 31, since the second MS is within the area of coverage of both the first and

10   second BSs. It is not important for the purpose of this embodiment which BS or BSs the first and second MSs 10, 35 are using for communication.

On determination that the bandwidth of the channel being used for communication between the first and second MSs 10, 35, which in this example is a UMTS speech

15   channel, is not sufficiently high to communicate, the first MS sets a 'more bandwidth desired' flag (not shown) to TRUE. Examples of situations in which this might occur are when video signals are being communicated, and it is determined that a higher quality of picture is required, or when it is desired to send other data, e.g. gaming data, along with normal speech call data. Another situation when this

20   might occur is when the channel type (and hence the bandwidth) is selected by a user or the users on the basis of cost effectiveness, when a higher bandwidth channel would be desired; for example when a speech call is in progress when a videophone call would be preferred. Since direct mode communication does not involve the transmission of large amounts of data over a network, it may be much

25   cheaper than network calls, or even without charge. As long as the 'more bandwidth desired' flag remains TRUE, the software operation given by the flowchart of Figure 3 is run on the first MS 10.

Referring to Figure 3, the operation begins in this instance at step 40, which

30   describes the connection status at this time. In this context, it will be appreciated that 'global connection' refers to connection via the base stations 30, 32-34 of the network 31. At step 41, the first MS 10 determines its location using its GPS receiver 23, and receives information identifying the location of the second MS35.

At step 42, the positions of the two MSs 10,35 are compared, and the distance between them calculated. This distance is then compared to values stored in a table which relate to predetermined feasibility parameters.. The operation of step 42 is performed relatively infrequently, so as to save resources, e.g. processing resources and to avoid the need for frequent sending of location and other subsidiary information over the network 31. A decision is made at step 43 as to whether the connection is potentially feasible, and return is made to step 41 if a negative, decision is made. Otherwise, the positions of the MSs 10,35 are compared again at step 44, and the distance between them compared to the maximum permissible distance in step 45. A threshold, which is the maximum permissible distance, is set at a value equal to the sum of the radio coverage of the first and second MSs, which coverages are made available to the first MS 10 in any suitable manner. The threshold and the maximum permissible distances are stored in the database 24. This calculation is made significantly more frequently than the calculation of step 42. If the threshold is exceeded, a NO result returns the operation to step 41. If the threshold is not exceeded, a YES result causes the operation to progress to step 46. Here, direct mode communication is established between the first and second MSs 10, 35 in any suitable manner. The global communication may remain in place or it may be disconnected. By step 47, local connection, or direct mode communication, is established and on.

At step 48, the first MS 10 again determines its location using the GPS receiver, receives location information about the second MS 35, and determines the distance therebetween. At step 49, this distance is compared with the threshold used in step 45, and a decision made as to whether the threshold is exceeded at step 50 with a NO result returning the operation to step 48, and a YES result causing progression to step 51. It will be appreciated that a YES result is obtained from step 50 only when the first and second MSs 10, 35 have moved apart so that their radio coverages no longer overlap. In this case, the operation takes the appropriate step, step 51, of switching communication from local (direct mode) to global (i.e. via at least one BS 30). If the global connection was broken at step 41, then step 50 involves establishing a global connection, in any convenient manner.

In a further embodiment (not shown), the switching of a global connection to a local connection is carried out only if an MS determines that a channel of sufficiently high quality can be established. This is achieved by the sending of data from the first MS via the first BS 30 indicating the channel which is to be used,

5   which information is then passed onto the second MS 35. The first MS 10 then transmits some test data via the identified channel, and this data is received by the second MS 35. The bit error rate (BER) of the received data is calculated in a conventional manner, and the BER transmitted to the first MS 10 either directly or using the global connection. The connection is switched from global to local at step

10   46 only if the first MS determines from the BER received from the second MS 35 that the propagation channel between the first and second MSs 10, 35 is of sufficiently high quality. Channel quality is determined continuously, along with the distance between the first and second MS s 10, 35, for the purpose of determining whether a switch from local to global communication should be made.

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Many variations of this are possible. For example, any other measure of channel quality may be made and used for the purpose of deciding whether to switch, examples being received signal strength and packet error rate. Also, a measure of the quality of the propagation channel from the second MS 35 to the first MS 10

20   may be made and this may be dependent on how much data is required to be transmitted across that channel.

The operation of the flowchart of Figure 3 does not need to be carried out by the first MS 10. Although it is preferred that the operation is carried out by the MS

25   which determines that a higher bandwidth channel of communication is desired, this operation may be carried out instead by another MS or by the BS 30 or some other part of the network 31. Running the operation of the Figure 3 flowchart other than in the first MS allows it to be of simpler design.

30   Reference is now made to Figure 4, which is a signalling chart having the first MS10 on the left hand side (Terminal A), the second MS35 on the right hand side (Terminal B), and the network 31 in the centre.

Referring to Figure 4, connection established signals 60, 61 are passed from
Terminal A to network 31 and from there to terminal B respectively once a channel
has been allocated respectively. Connected signals 62, 63 are sent from terminal B
and from the network 31, respectively, in response. Communication between the
5   terminals A and B is then established over a first channel, as is indicated at 64. The
network 31 subsequently, and while the channel 64 is still open, transfers location
information to terminal B and to terminal A with signals 65 and 66. In the
embodiment of Figure 3, it is not necessary to send signals 65 and 66 because
location information is not stored on the network 31. In other embodiments (not
10 shown) however, a location information network (which may or may not form part
of the network 31) is used to calculate and to hold information about the locations
of the MSs 10 and 35, and this information is passed to one or both of the MSs
before direct-mode communication can be established. Identification and location
information, as well as any other required information, is then passed between the
15 terminals by signals 67 to 70. Afterwards, direct mode communication is
established by the sending of a connection establishment signal 71 directly from
terminal A to terminal B and by a communication signal 72 sent in reply. Direct
mode communication is then established at 73.

20 The location of the first and/or second MSs 10, 35 may be determined in any
suitable manner, such as by triangulating signals from plural base stations of known
locations as is known. The triangulation calculations may be carried out by the
network 31 or by the relevant MS 10, 35.
Location information for each MS may be stored by the network 31, and be
25 accessible by any station as and when required. Location information may be
transmitted to an MS by SMS message, which is particularly convenient since SMS
messages can be received without interruption of any ongoing speech call.

In an alternative embodiment (not shown), the second channel has a bandwidth
30 equal to or less than the first channel.